CNC MACHINE

VOLUME 2
NUMBER 5
SPRING '98

COVER STORY

Aircraft Engineering flies into production with Haas

FEATURES

Swift Engineering goes faster with science

Your CAD/CAM questions answered

Precision Billet cranks up productivity with Haas CNC machines

VOLUME 2 SPRING 1998
NUMBER 5

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On the Cover

When you're pulling 6 G's or travelling at twice the speed of sound, the last thing you want to worry about is the quality of the parts holding your plane together. This month's cover story tells how Aircraft Engineering Corp. of Paramount, CA, is helping eliminate that worry on both the military and commercial fronts.

Photo courtesy Comstock 800-225-2727

[Product Release]

Who says size doesn't matter?

WHEN it comes to machining big parts, size really does matter. The ability to machine a long, wide part without refixturing is a sure way to increase productivity and reduce cycle times.

Designed for machining extra-long and extra-wide parts, such as wing spars and molds, the new Haas VF-11 Vertical Machining Center features travels of 120" x 40" x 30" (xyz). Built of heavily-ribbed, American-made iron castings for structural integrity and rigidity, this C-frame VMC utilizes triangulated, wide-stance construction to damp vibration and prevent flex. For extremely precise positioning, linear (glass) scales are available as an option.

The VF-11's standard 20-hp motor drives a 40-taper spindle to 7,500 rpm through a vibration-isolated, two-speed gearbox. For high-torque cutting a 30-hp, 50-taper spindle is optional, and a 10,000-rpm spindle is available for high-speed work. A 20-pocket automatic tool changer comes standard on the VF-11, and a 32-pocket tool changer is optional. Both changers feature tool-to-tool change times of approximately 5-seconds, and are fully-enclosed to protect tool tapers from chips and coolant. A load-sensing chip conveyor removes chips from the enclosure to reduce idle time, and automatically reverses should a jam occur.

At the heart of the VF-11 is the highly-refined and user-friendly Haas CNC control. Built around the operator, this control is constantly being improved to ensure optimum performance. Featuring dual, high-speed 32-bit processors, and program execution speeds up to 1,000 blocks per second, the Haas control is fully FANUC™ and YASNAC™ compatible. This, along with unique Haas OneTouch™ features, such as OneTouch™ power-up and OneTouch™ tool offset, combine to establish the Haas control as the industry's benchmark for productivity and ease-of-use.

Expansion Underway in Oxnard

IT has been less than a year since the grand opening of Haas' new 420,000-square-foot facility in Oxnard, and already it's time to expand. With sales hitting another record high in 1997, and '98 shaping up to be more of the same, the fastest growing machine tool builder in America is set for another growth spurt.

Excavation has already begun for another 200,000-square-foot building adjoining the existing facility. This new addition will enable Haas to expand its existing production lines and increase machine shop capabilities, as well as house one months worth of finished machine stock to improve shipments to customers. The first of two planned expansions, Haas II is scheduled for completion by mid year.

At present, Haas is shipping more than 500 CNC machines per month out of the current facility, with a maximum capacity of 600 machines. The addition of Haas II will increase the overall capacity to about 800 machines per month.

1998 Haas World Tour Goes to Chicago

LAST year, the biggest show on the Haas world tour was EMO Hannover in Germany. This year – though there are some international venues – the largest show is closer to home at IMTS 98 in Chicago.

IMTS (International Manufacturing Technology Show) is the largest industrial exhibition in the Americas. Scheduled for September 9–16, 1998, this biennial show is held in the nation's largest exhibition complex: the East, North and South buildings of McCormick Place in Chicago, Illinois. The entire show covers an area equal to 32 football fields, or about 1.3 million square feet. On display will be more than $350 million worth of metalworking equipment, materials, accessories, controls and component parts.

Of course, Haas will be at the show in force with enough machinery to fill its 10,000-square-foot booth. Expect to see most, if not all, of the Haas product line hard at work cutting parts – including the latest new machines.

The Haas Automation booth will be located in the Metal Cutting Pavilion in the South Hall in space #8232. This huge Pavilion will feature metal cutting machines, machining centers, turning centers, milling, boring, and drilling machines, as well as jig boring / milling equipment and much, much more.

Attendee information is available at the IMTS toll-free number 800-322-IMTS or check the current IMTS information on the Internet at http: / / www.imts.org.

Trade Show Calendar

April 18-25	EMAQH	Buenos Aires, Argentina
April 21-23	Greater Cleveland Machine Tool Show	Cleveland, OH
April 22-27	SIMTOS '98	Seoul, Korea
April 27-May 1	MACH '98	Birmingham, UK
May 5-9	Die & Mould China '98	Shanghai, P.R. China
May 19-21	EASTEC	W. Springfield, MA
May 26-29	AIEE	Sydney, Australia
Sept. 9-16	IMTS	Chicago, IL

Racing Report

Dale Wins But Hendrick Motorsports Leads Pack

NASCAR's 50th season opened February 15 with the roar of new engines and a flock of four-door Fords (Taurus) slamming doors and scrubbing rubber to grab the Daytona 500 crown before 185,000 standing and screaming spectators. The crowd favorite and eventual winner Dale Earnhardt finally broke his 20-year curse taking his first Daytona 500 checkered flag and earning a hand-slapping row of congratulations from the NASCAR pit crews. An untold number of fans, machinists and Haas dignitaries also rooted for the Haas-sponsored Hendrick Motorsports team as they returned to defend their remarkable 1-2-3 finish at last year's running.

The pack accelerated to speed as the starter gave the green flag to Terry Labonte in the Haas-sponsored Hendrick Motorsports Kellogg's Monte Carlo (#5).

Defending NASCAR Winston Cup champion Jeff Gordon (Hendrick Motorsports DuPont Monte Carlo #24) then began his incredible run up to the front from the rear of the pack to eventually take over the lead on lap 59, showing the rest of the 43-car field what to expect in '98.

Gordon maintained the lead (with a break at lap 107 when Hendrick teammate Labonte took over for two laps) for a total of 54 of the 200 scheduled trips around the celebrated Florida track. Gordon's challenge finally faltered when he dropped a piston in the final few laps, sending him back to a sputtering 16th-position finish behind teammates Labonte in 12th, and Ricky Craven (running the Hendrick #50 Bud Monte Carlo) in 14th.

Keep an eye on the winner's circle at the upcoming NASCAR races and you'll probably see quite a few return visits by the Haas-sponsored Hendrick Motorsports team. The Hendrick trio of Chevrolet Monte Carlos carry the "HAAS CNC" sticker directly in front of the rear wheels on either side of the cars.

PacWest CART: PacWest's Mercedes powered Reynards will carry the Haas logo in '98

Haas has joined PacWest Racing Group as a Technology Partner / Sponsor in support of PacWest's ongoing FedEx Championship Series competition. Haas will supply PacWest with two CNC vertical mills, two lathes, and technical support. The Haas logo will appear on the Reynard / Mercedes-Benz cars driven by Mauricio Gugelmin (#17) and Mark Blundell (#18) that PacWest campaigns in the FedEx Championship, as well as the PacWest entries in the PPG Dayton Indy Lights Championship.

"Haas is thrilled with the opportunity to partner with PacWest Racing Group," said Gene Haas.

CNC machine tools will produce a winning combination. PacWest will provide the ideal laboratory to showcase the Haas product line."

PacWest is recognized by the racing community as one of CART's most competitive teams. In 1997, the team claimed four victories and three pole positions with a total of 18 "Top 10" finishes.

"Having the best and most advanced equipment is a prerequisite in racing," said John Anderson, PacWest's Vice President of Race Operations. "The addition of the Haas CNC equipment will be a great asset to the PacWest design and technical team. The benefits of being able to design and manufacture 'in-house' are immeasurable."

For the 1998 season, PacWest will continue with the same successful racing platform used in 1997, running a Reynard chassis powered by the advanced Mercedes-Benz engine on Firestone tires.

PacWest Wire:

"Big Mo" Mauricio Gugelmin took to the track with two minutes left in the final session of Spring Training at Homestead, Florida, and ran a series of fast laps culminating in the best lap of the session.

"We weren't here to qualify," commented Mauricio, "But it was nice to show we do a quick time when we need to." With the top runners lapping 10 mph faster than last year, he finished the session just 0.164 seconds behind overall fast time. "Big Mo" ended up third overall and said, "The car and the new Mercedes engine have a lot of potential."

Blundell's track time was cut short due to some minor problems, but he said he ran some productive laps in the morning.

Continued on page 30

Ongoing design Advancements...

20-hp vector spindle drive

Using the same closed-loop technology as our brushless servo motors, this Haas-designed vector drive optimizes the slip angle between the rotor and stator of the spindle motor to double low-speed torque and acceleration, resulting in the fastest and most powerful spindle output ever.

20 HP VECTOR DRIVE

Anti-flex torque-tube base casting

The specially designed Haas torque-tube base casting yields superior rigidity and provides the most anti-flexing, vibration-damping properties of any base design. It's so stable, in fact, that the machine will cut accurately with one leveling bolt removed, and it doesn't require any special foundation for installation.

PowerUser control enhancements

The Haas control now employs dual, 32-bit Motorola processors that feature 1 MB of high-speed cache memory on a 40 MHz chip. This enhancement provides program execution speeds up to 600 blocks/sec (1000 blocks/sec optional). The dedicated Haas design provides more stability and higher throughput than today's fastest PC-based systems, all without the worry of crashing or locking up. In addition, you can now upgrade the memory on our control to 16 MB of static RAM that retains memory changes instantly and permanently.

Large turret coupling

To achieve fast indexing and superior reliability, we employ an 8-inch-diameter face coupling on our turret to provide indexing repeatability within 3 arc-seconds. Since the turret is servo-controlled, it will index to the next tool in 1 second, or the opposite tool in 2 seconds.

The smartest jog handle you've ever seen

The jog handle on the Haas control can be used to edit programs, override spindle speeds and feedrates, single-block-scroll through programs, and so much more that you'll wonder h you ever got along without it.

HaasValue

Ongoing engineering and design advancements with no price increases! How can we do it?

At Haas, we have two simple guidelines for engineering: (1) Make the machines better, and (2) Get better at making machines. Our engineers understand the economic rewards these two principles provide for our customers.

Considerable effort and resources are invested to continuously upgrade our machines, while improving the overall manufacturing process.

Simply put: We make the investment, you get the benefits.

Change Everything But Our Prices.

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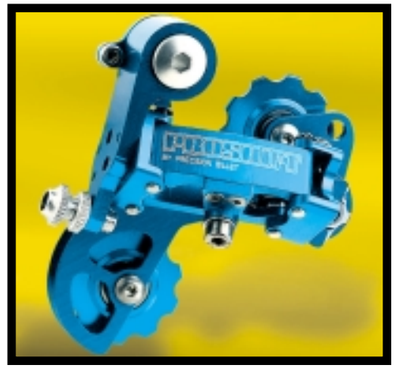
www.HaasCNC.com

HAAS

Precision Billet Cranks Up Productivity With Haas Brushless Axis Motor Machining Centers.

Story and photos
by preston gratiot

You're flying down a rocky ski run and the trees are just a greenish blur framing the perilous path ahead. This is not the time to worry about your components, and the fact that there is no snow on the ground is of little consolation. If you miss the next apex, you're likely in for the biggest "face-plant" of your life, and insurance doesn't cover this kind of downhill dementia... This is no time for cheap bicycle parts!



Precision Billet designs, manufactures and markets a proprietary line of mountain bike components.

Precision Billet is a high-end job shop and manufacturer of the specialized, high-performance cycling components that you can depend on in this fast-paced world of gonzo biking.

Precision Billet, true to the sport, recently shifted gears, took a calculated chance and replaced several of its older machining centers with three new Haas Automation VF-0 brushless servo motor machining centers. This single production change sent productivity rates climbing by more than 25-percent.

Bolstered by this success, the shop soon replaced another aging piece of equipment with a new Haas HL-2 CNC lathe. Payback was reached in just nine months, again with an impressive gain in production efficiency. And so, as the company continues to grow, so grows the number of Haas machines on the shop floor. . . Precision Billet has just added an additional HL-1 lathe to its mechanical workforce.

Precision Billet, situated in Santee, California, fabricates a wide array of high-tech components for the highly competitive mountain bike business. The company designs, manufactures and markets a proprietary line of mountain bike and bicycle motocross (BMX) components under the brand names ProShift and Atomic Industries.

The machined-billet product line includes operator-serviceable front and rear derailleurs, handle bar shifters, brake levers, brakes, hubs and adapter clamps. In addition, as a job shop, Precision Billet also makes parts, including pulleys, frame and suspension components, for other bicycle manufacturers.

Three of Precision Billet's Haas VF-0s with brushless motors.

Proof in Production

"Where most job shops specialize in quantities of less than 100 parts or so, we make lots of up to 10,000 pieces, so every second of cycle time is critical," said Gary Hickman, president of Precision Billet. "We know there's a big difference with Haas brushless servo motors because we still have one machining center with brush servo motors and set the same job up on both types of machining centers to make a comparison."

The comparison of brushless verses brush servo motors was made with a component called an aluminum backstop (cable hanger). Typically, Precision Billet machines 1,000 backstops in a normal production run. Five tool changes are required to machine the backstop, including a $^1/_2$" endmill, #2 center drill, $^1/_8$" drill, keyway saw and a 45° endmill.

"We set both machines up to run the backstop," said Hickman. "The Haas machining center with brushless servo motors finished 1,000 parts in 16 hours. The machining center with DC servo motors required 20 hours. The high-speed rapids and cutting feed rates of the brushless servo motors proved their worth by saving one-half day of production time."

Group Ganging

Because many of the parts machined by Precision Billet are small extrusions or other odd shapes, Chick vices are employed to increase throughput by grouping multiple parts in a single cut program. According to Hickman, the multiple-piece vices do a much better holding job while reducing manual operator time in running large part orders.

Controls and Cycle Time

Another feature of the Haas machining centers that Hickman appreciates is the control. Precision Billet utilizes several CAM programs for offline programming, such as EZ Mill for 2D parts and Geopath for advanced 3D parts, such as brake handles.

"The Haas control is very powerful with a lot of features, such as 100 tool offsets and 26 work coordinates, a floppy drive, text editor and graphics. It's faster and makes it easier to get parts into production," said Hickman. "For example, the Haas control allows the operator to view the cycle times for each tool by selecting the tool life display screen. The display shows the total cycle time, feed time and number of uses. By subtracting feed time from total cycle time, we can determine the time spent cutting air. We use these figures to reduce excess moves and are able to cut cycle times by as much as 30-percent. Plus, tool life calculations can easily be made by estimating the number of uses for each tool and inputting an alarm number for each tool."

With the Haas control, work offsets can be set in the CNC part program and the offsets can be verified on the control. To do this, the operator runs the program from the control's graphics page. If a wrong number has been keyed in or a decimal put in the wrong place it will be immediately visible.

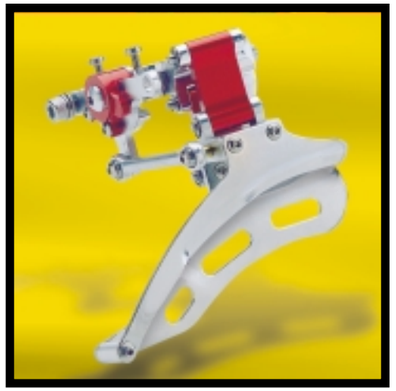
"By verifying part programs on the control before proving them on the machine, we avoid scrap parts and tool breakage," said Hickman. "And the Haas control is fast. We can load ten tool offsets in the same time it took our previous machines to load two tool offsets."

Gary Hickman at the control of the Haas lathe. Precision Billet has reduced programming time substantially with several control features unique to the Haas lathe, such as G81, G83 and G84 canned drilling cycles identical to those found on mill controls.

Latest in Lathes

Precision Billet previously owned a 1983 vintage CNC lathe. When repeatability problems became apparent, a Haas HL-2 CNC lathe was purchased. Continued productivity and growth in the marketplace →

ProShift's derailleur systems are completely user serviceable with replacement parts available. Very important features for rough & tumble mountain bike enthusiasts.



soon had Hickman on the phone ordering another HL-1 lathe.

"We found that lathe controls had not progressed as much as machining center controls," said Hickman. "But the Haas lathe was surprisingly easy to operate. Setting tool offsets is easy and turret indexing is quick and precise. We saw a demonstration of the lathe cutting steel and were convinced to buy it.

"Mostly, we turn brass or aluminum," said Hickman. "With the Haas lathe, we can hold 0.0002", even when we start it stone cold in the morning. We can put in a fresh bar and the diameter will be within a tolerance of plus or minus 0.0002"."

Precision Billet has reduced lathe programming time substantially with several control features unique to the Haas lathe. For example, G81, G83 and G84 canned drilling cycles are identical to those found on mill controls. And the Haas lathe control can be programmed in either FANUC™ or YASNAC™ mode, the latter most commonly used at Precision Billet.

Cycle times have decreased even more because the new HL-1 has AC drives with 710-ipm rapids.

"Typical lathe cycle times are 50 percent faster because of faster rapids and turret indexing, as well as higher feeds and speeds. Setup times have also decreased by 50 percent due to ease of tool offsetting and Haas' unique turret tool holders. We have tool holders set up for specific jobs. All we have to do is install a new holder in the turret. Repeatability is high enough that offsets can be preset for that specific job," said Hickman.

Computer-designed and machined out of 6061 T-6 aluminum, the Protwist Shifters replace factory plastic.

Production + Payback = Success

"During the past 12 months we have quadrupled our growth rate. We can make 500 rear derailleurs a week, instead of 500 a month. Payback on the VF-0s has been less than a year," said Hickman. "Plus, we have more time to design, prototype and make new products. Haas' speed, accuracy and ease of setup have allowed us to increase our throughput. And the faster we make parts the faster we get paid."

Precision Billet
9437 Wheatlands Ct., #A
Santee, CA 92071
619-448-4508

Product photos courtesy Precision Billet

The Precision Billet crew can load ten tool offsets on the Haas VF-0s in the same time it took to load two tool offsets in the previous machines.

Speedway Engineering Shifts Into High Gear

Story
by clint crowell
Photos
by gerard burkhart

The people at Speedway Engineering eat, drink and breathe racing. The walls of the front lobby are covered with framed pictures of cars and drivers running Speedway Engineering parts to reach the winner's circle. People like NASCAR Winston Cup greats Rusty Wallace, Darrel Waltrip, Robert Yates and Bill Elliott. . . Speedway parts were on the Winston Cup car that won the Brickyard 400 last year. . . Richard "The King" Petty won his last national championship with a Speedway Engineering chassis... Bobby Labonte took the pole at this year's Daytona 500 with Speedway parts... the list goes on.

Speedway Engineering is the life's dream of one skilled welder and machinist named Frank Deiny; a man who had a passion for auto racing and the courage to follow his vision. The family-owned small business has been making premium quality driveline components for auto racing since 1964. Throughout the years, growing demand for Speedway parts has steadily increased revenues. With the recent addition of a Haas VF-4 vertical machining center to their shop arsenal, they have broken the million dollar mark in yearly revenues.

Like thousands of small manufacturing shops around the world, Speedway is testament that loyalty, persistence and the pursuit of excellence – along with sound business decisions – bring success. It began with Deiny working the night shift at his full-time job, so he could work on race cars during the day. He eventually earned enough money as a welder building roll cages to buy a lathe, then a grinder. In 1967 he opened his shop and never looked back.

Ken Sapper, who had been with Deiny almost since the beginning, became president of the 11 person, Sylmar, California company when Deiny tragically passed away from cancer in the late 80s. "We began building parts for modified cars like the '57 Chevy for oval-track racing," Sapper began as he explained how they discovered their niche. "As the sport of stock car racing evolved, the speeds increased, so we manufactured purpose-built cars. By creating competitive cars, we created a parts market for ourselves."

But building cars was a time consuming and labor intensive process. After looking at the numbers, they realized it took them four weeks to build a car they could sell for $8,000, but only half a day to build a quick-change rear end they could sell for $1,500. They stopped building cars and focused on parts.

Today, Speedway manufactures quick-change rear ends based on custom-made aluminum castings; full-floating rear ends based on 9" Ford SVO housings; anti-sway bars; front hubs; drive flanges; axles and other miscellaneous parts for teams racing in the Winston Cup, Busch Grand Nationals, Craftsman Truck, NASCAR touring division and the Winston late model series.

photo courtesy Interstate Batteries

Speedway Engineering parts helped Bobby Labonte take the pole at this year's Daytona 500.

"Our products became so popular over the years, we couldn't keep up with demand," said Sapper. "We had two CNC lathes feeding one mill. Outside of axles, everything we do needs a secondary operation in a machining center. We need holes, grooves, slots, tapping, you name it, we've got to do it. We were always backed up. We couldn't sell any more parts, because we couldn't make any more."

Paul Douglas, shop foreman and CNC programmer, likes the programming ease and flexibility of the Haas control.

Speedway Engineering needed a machining center. They already had a small gear-driven mill that gave them good service, so they knew they wanted to stay with a transmission-driven unit. "We liked the Haas VF-4 when we saw it, because it was American made, had the right combination of power and flexibility and was easy to operate. The service behind the machine was also a big consideration."

Since bringing the VF-4 on-line a year and ten months ago, Speedway's production has jumped tremendously. They were able to increase sales more than 30% last year – without adding a single person. To meet increased demand since then, however, Speedway has added a machinist and staggered shifts to keep the VMC running 13 hours a day.

"I'm not a Haas salesman; I'm a user," commented Sapper, "so I don't know all the jargon. I can tell you it flies through aluminum and is a good, rigid machine. Our scrap rate is phenomenally low. We are cutting 8620 forged steel and 4140 heat-treated forgings; the machine doesn't make the floor jump, so it must be doing okay. And we are holding tolerances of ±0.002", because if everything doesn't run true on our assemblies, at 200 mph it's going to shake the driver's teeth out."

Setups at Speedway vary greatly. Some jobs run a few hours, while other times they run the same job all week. And when the machine is open, they use it to do "one-off" jobs. The size of the VF-4's table (52" x 18") allows them to set up as many as three separate jobs on the table with tools hung. This lets them skip around and stay ahead with production. The repeatability of the Haas has been a great asset in these cases. The large table size and long z-axis travel have also allowed them to reduce setups. Using a Haas 5C rotary indexer – the first product ever manufactured by Haas – Speedway is able to machine all four sides of the large center castings for their rear end assemblies in one operation.

Before getting the Haas, Speedway was only able to run four drive plates at a time on their smaller mill. But with the VF-4, they're able to run 20 pieces at once – a production increase of 500%. They set it up on the machine and three and a half hours later all the plates are done.

Machinist Joe Landy said, "The 'Next Tool' button and other little touches make setup a breeze. With our other mill you have to do 12 things to change a tool. With the Haas it's just one button."

Shop foreman and CNC programmer Paul Douglas added, "The Haas will run a four-hour job without us even looking at it, allowing us time to work with the other machines.

"I also like the fact that the control is built around the machinist," Douglas continued. "The 32-bit processors and memory capacity give us the ability to program the control to help out and create shortcuts. The programming ease and flexibility of the control, as far as manual input is concerned, are very helpful and user friendly."

At Speedway, jobs are programmed right at the control panel using Haas' QuikCode, which combines the power and flexibility of G-code with descriptive English sentences. Both Landy, who is relatively new to machining, and the more experienced Douglas write the programs. Because the Haas programming is so efficient, Landy said, they initially didn't plan on getting a CAD/CAM system. They ended up needing one, however, to program their other CNC machines.

Sapper sent Douglas and Landy for operator training at the local Haas distributor, and three days later, they could run the machine. "We sent them before the VF-4 was delivered to the floor," said Sapper, "so they were familiar with it and could jump in and run it when it arrived. As soon as power was run to the machine, the Haas service guys were out here leveling it and setting it up. Everything was very well coordinated."

Up until July of '97, Speedway Engineering produced their entire product line without the use of a CAD/CAM system: Everything was programmed on the Haas control and the files were stored on floppy disks. To speed program changes and development of new products, however, the Haas is now hard-wired to a PC equipped with a CAD/CAM system.

Today, Speedway Engineering has shifted into high gear to meet the increasing demand for their products. The Haas VF-4 is enabling them to reach a new level of productivity to enter new markets and expand their product line. They are now racing toward their next million dollar benchmark. . . and their next Haas machining center.

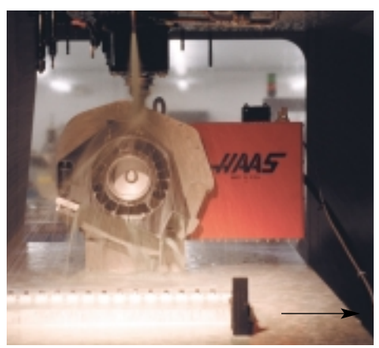
Speedway Engineering Sylmar, CA
818-362-5865
e-mail: speedway@pacbell.net

to the Swift goes the Checkered Flag

Photo by Michael C. Brown

Story and photos by preston gratiot

Downsizing is one of the big catchwords in industry today, but Swift Engineering Inc. is taking this science to a new level by designing full-size cars and then using a computer program to shrink them down to 45-percent of their original size. These cars are then suspended above an oversized belt-sander and blasted with winds of up to 140 mph... all in the name of science and technology.



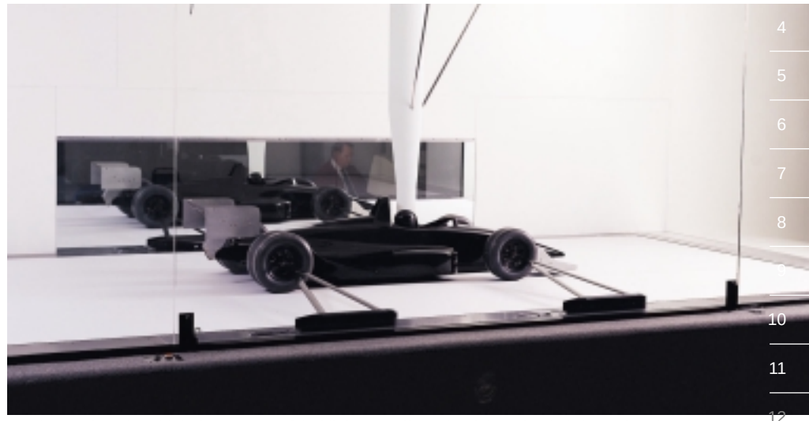
This process is only one of the many test procedures a race car is subjected to before a full-size model is assembled on the Swift production floor.

Recognized as a world-class designer and builder of highly successful race cars, Swift is currently constructing entries for two of the most hotly contested international auto racing series: the CART FedEx Championship and KOOL/Formula Atlantic. Designs are tested for aerodynamic efficiency in a state-of-the-art wind tunnel of Swift's own design. One of only four of its type in the world, this tunnel is just one of the tools Swift uses to maintain the edge necessary to outpace the competition in the ever changing arena of international auto racing.

Staying on the cutting edge requires the harmonious blend of technologies to produce a winning piece of machinery. Swift achieves the absolute accuracy and repeatability necessary through the use of computerized modeling methods and the precision machining capabilities of CNC machines from Haas Automation, Inc.

Body components use latest carbon fiber technology.

Alex Cross, Executive Vice President of Swift Engineering Inc., puts it this way, "Our use of modeling in conjunction with the Haas VF-8 machining center and HL-2 CNC lathe allows us design-to-production accountability. It provides the capability to redesign the various body panels of the cars on the computer and accurately machine them – a major plus when we have to account for changes in downforce in the nature of 20-pound increments."



By using a precise scale model sized at 45-percent of the full-size car, Swift uses its wind tunnel to check the aerodynamic forces generated by different body panel modifications.

Swift's wind tunnel evaluation models are usually 45-percent versions of the 100-percent file, explains Cross. "So when we test in the tunnel, we are testing an exact replica of the car. This is because the source information used to make the scale molds and body-work for the wind tunnel model came off the same computer file as the full-scale model."

For instance, the engineering file on bodywork in the computer provides the surface contour information to the CNC milling machines, "which is best described," says Cross, "as almost literally the paint surface."

This same file is used to create a tool on the CNC machine to make the mold used to lay up the composite parts for the full-size or scale model for testing. Same file, but a different scale, just by reducing the specified end size of the parts.

While most of the body parts used in both the scale and full-size models are carbon composite parts laid up and cured in the autoclave (a pressurized oven used to cure the parts), some parts, such as the wings and canards for the scale model, have to be machined out of solid aluminum billet on the Haas VF-8, because the carbon composites cannot be made thin enough to replicate the part to scale, yet still support the forces exerted on the part.

"Our experience is that if we make the tooling right, we will be able to make the parts right," Cross continues, "parts that will fit and perform as designed. So we spend a lot of time making sure we get the tooling right. We are committed to the process and depend on the reliability this CNC-produced repeatability gives us."

On Track Performance

Indeed, Swift's meticulous computer-assisted control of composite body panel development and chassis design was proven by the company's out-of-the-box win at its first race with the Newman/Haas Racing Swift 007.i at the 1997 PPG CART World Series opener in Miami, Florida. With little more than a year having passed since the designer sketched the first, rough rendering, this virgin victory illustrates the value of design-to-production control.

Team drivers Michael Andretti and Christian Fittipaldi have high hopes for the California-built racer. And while developmental problems are expected, the latest version of the car, the Swift 009.c, is living up to team hopes and dreams. Changes in the new car include significant advancements in both the aerodynamics and suspension, along with a redesigned six-speed gearbox. ➨

Andretti noted that while racing with his previous manufacturer, the team was provided with only one aerodynamic development piece during the entire racing year. Thanks to Swift's on-site wind tunnel and their "design-to-production" capabilities, the team will be testing and incorporating new designs throughout the season. "This program is not going to sit still," he said. We're going to be putting new pieces on the car all the time."

As it is, the Swift 007.i – in this case, the name Swift has nothing to do with birds, speed or newt-like creatures but was chosen by Cross because of the historical race car, "The Swift" – was the first American-made Indy Car chassis to win a race since the season opener in 1983, when Gordon Johncock drove the Wildcat to victory.

Win on Sunday, Sell on Monday?

Swift is looking to the 19-race '98 FedEx CART series (formerly the PPG CART series) to further establish its reputation as a builder of winning race cars. This reputation stretches back to 1983 when Cross, Paul White and Dave Brun, a flight test engineer from McDonald Douglas decided to enter the world of race car construction. While they could drive formula (open wheeled) race cars quite well, their real expertise lay behind the scenes, with Brun as the designer and Cross as the organizer and front man. Swift Engineering was formed with winning in mind.

Swift's latest Formula Atlantic racer, the 008.a.

As with most new companies, Swift was short on funds but brimming with enthusiasm. If they were going to sell cars, they first had to prove that their cars could win races. So with a new Swift DB1 / Formula Ford in tow, the crew drove to the Formula Ford Championships in Atlanta.

"We had one shot," says Cross. "Our car either performed well in that race or we hitchhiked home, broke and defeated." The car, driven by another new partner in the fledgling business, R.K. Smith, took the checkered flag, and the rest, as they say, is history.

The win meant competitors began placing orders for dupes of their winning entry. As Cross says, nobody wants to drive a loser, especially on the race track. "We had orders, with deposits, before the engine had a chance to cool down," remembers Cross with a smile.

Of course the new Swift 009.c isn't expected to sell in the hundreds (Swift is scheduled to build six 009.c chassis this year), but it does carry a $425,000+ list price...not counting spares. This means that while Swift Engineering will probably make some money manufacturing additional customer cars, the "Selling on Monday" will be centered on selling the company name as a respected engineering / design force of the likes of Porsche Design or Lotus Engineering.

Swift machines and taps uprights for their CART chassis using Haas HRT-210 rotary table on a VF-8.

Big Bucks and Luck

"The Indy Car program, aside from being one of the premier racing venues in the world, is part of our plan to establish our company as a leader in technological development and engineering," says Cross. "If you can build a winning race car in one of the most competitive racing series in the world, you are obviously capable of doing a lot of other things."

This plan includes eventually working with the major auto makers and other manufacturers of technological devices all over the world. However the road to this goal demands dedication, quality and a lot of luck.

The young company survived the early years on the racing successes of the Formula Ford cars. Then in 1987, Swift produced its first Formula Atlantic car, the Swift DB4. It was also in 1987 that a young Japanese driver entered the scene determined to make a name in America's Formula Ford series.

This young driver soon hooked up with Alex Cross as his driving mentor and eventually served to provide the financial resources and contacts in the world marketplace that would make Swift an international entity.

His family name well known throughout the world, young Hiro Matsushita wanted to be a professional race driver. He advanced quickly, and in 1991, he became the first Japanese driver to qualify for the Indianapolis 500. It was also the same year Matsushita International, including Hiro's real estate business, bought Swift Engineering.

This now set the executive lineup at Swift to include: Hiro Matsushita, President and Chairman of Swift Engineering; David Bruns, Technical Director and Vice President of Engineering; Jim Chapman, Vice President of Manufacturing and Alex Cross, Executive Vice President, Operations.

From this point on, the Swift Engineering team started moving towards its long-range goals in earnest. But in order to make the jump to the big leagues, Swift had to stop building the so-called amateur race cars and start building a company capable of producing machines to compete in the rarefied world of big-time racing.

So Swift shut down production and relocated to a new 60,000-square-foot facility in the hills overlooking San Clemente, California. It was here that Swift began construction of a new state-of-the-art wind tunnel facility, a facility that, when used in conjunction with the programmable accuracy of Haas CNC machines, would revolutionize race car design.

A Light in the Tunnel

To be a leading contender in the international automotive engineering game, Swift was going to need frequent access to a world-class wind tunnel, preferably a high-tech wind tunnel designed to evaluate automotive aerodynamics. However, access to most of these wind tunnels (located in Europe) is monopolized by the Formula One teams, and time would only be available on a sporadic basis.

This prompted Swift to consider building their own tunnel in the States – a costly venture, but one that would promise easy access and, as an added bonus, income from stateside tunnel time rentals.

This advanced technology demands a moving ground-plane to accurately plot the downforce and aerodynamic forces of a vehicle driving through seemingly motionless air.

Not an easy task if the only way you can approximate the effects of a vehicle at speed is to accelerate the air around it. If the "ground" under the car in the wind tunnel isn't moving at the same speed as the surrounding air, the ground will form what is known as a "boundary-layer" of slower air on any surface that is moving past it. (Note: This is why you can never drive fast enough to "blow" the dust off your car.) This ground-to-air interaction also includes the ground under the car, and since this doesn't reflect the real-world parameters a speeding race car feels, the aerodynamic test results will be inaccurate.

To remove this unwanted layer of dirty air, a moving ground plane is approximated by employing an oversized belt not unlike those found on a belt sander. Only this belt is 94-inches wide and 38-feet long! In addition, a vacuum is used at the leading edge of this belt to suck away the existing boundary-layer that has formed as the air is blown through the tunnel itself.

Another vacuum system is incorporated to hold the belt flat to the base as it rolls under the test car. This is necessary because the cars generate so much negative pressure underneath the car that they literally suck the "ground" up towards them. Cross explains that this massive aerodynamic downforce is so powerful that if a Swift 009.c running at 230 mph could run on an inverted, upside-down track, it would defy gravity and continue running as if rightside-up due to the massive aerodynamic downforces generated by the body and wing designs!

Contracted time in the Swift tunnel is a costly and secret affair, but the results are worth the expense. The cost of this advanced facility – in the vicinity of $6 million – is currently being repaid through extensive use by numerous Formula One and NASCAR teams and the Big Three automakers, all of which are lined up to use the advanced facility. Cross says they could have built a more economical tunnel, but then they probably wouldn't have as many teams waiting in line to book time on it.

Operated as a separate division under the Swift Engineering banner by noted aeronautical engineer Doug Smyth, the Swift Aero building is as secure as a top secret government operation. "Customers demand this, as advanced technology is the racer's edge, and this science of aerodynamic weaponry is as closely guarded as any advanced defense project," said Cross.

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“Get Me a Contract and I’ll Buy a Machine to Do It!”

Photo USAF John K. McDowell

Story and Photos

by scott rathburn

Back before the onslaught of big time mergers, buyouts and corporate downsizing, the cart often came before the horse with regard to procuring aerospace contracts. Shops would bid jobs for the major manufacturers without necessarily having the machinery on hand to make the parts. Only after eliminating the competition and securing the job would they purchase the equipment necessary to fulfill the contract.

In today's world, things are different. As more shops enter the fray for a slice of the aerospace pie, manufacturers like Boeing, McDonnell Douglas and Martin Marietta are looking for suppliers that already have the capacity and capability to do the work. No longer are they willing to wait months – or even years – for their parts.

This fact has become the driving force behind Aircraft Engineering Corporation (AEC) of Paramount, California. Over the past year and a half they have added nine vertical machining centers from Haas Automation, Inc., to their equipment list, including three VR-11 five-axis profiling VMCs. Additional Haas machines are scheduled for arrival early in 1998. They are determined to have the machines on the floor to handle any job that comes their way.

"The mentality used to be: Get me a contract and I'll buy a machine to do it," explains Cliff Kenney, AEC's procurement manager. "Now, if you don't have the machines on the floor ready to rock and roll, you don't get the contract. So, either you're staffed and ready to run, or you're not going to get the work."

The travels of the Haas VF-10 allow Aircraft Engineering to machine long parts like these 82-inch-long stringer splices with ease. Steve Larabee monitors the process in the background.

Hal Purdy sets up a Haas VF-6 to machine emergency escape hatch brackets. The large table of the machine allows Aircraft Engineering to machine nine pieces at a time for high productivity.

AEC has been a major supplier to the aerospace industry since 1959. For most of those 39 years, they've been known primarily as a tooling house: building aircraft assembly tools, fixtures and ground support systems for the major manufacturers. But tooling is typically a one-shot deal – once the tools are made, the job is done. Additional tooling is usually unnecessary until a new aircraft design is ready for implementation.

For years defense contracts provided a steady flow of work for AEC and a myriad of other aerospace shops. There was enough work for everyone as defense spending ballooned to record highs. But it couldn't last forever. Fed up with the American government's spending us all into recession in the name of national defense, the public called for cutbacks. Many shops closed their doors forever as the flow of defense work slowed to a trickle.

AEC was one of the shops to successfully survive the ensuing lean years, and thus was able to capitalize on the next aerospace boom: commercial aircraft. An improving economy, combined with aging planes reaching the end of their operational life saw airlines once again investing in new fleets.

Unfortunately, most of the commercial aircraft being built were based on existing designs, so there was little call for new tooling. There was, however, a demand for production airframe parts and new tooling. With the number of suppliers seriously reduced by the previous slump, there were now more contracts than suppliers to fill them.

AEC decided to take advantage of this tremendous potential by diversifying their operation and manufacturing production airframe parts to supplement their tooling. According to Kenney, this idea had been kicked around for years, although AEC initially tried to stay out of production work. "A lot of customers don't like to mix their tooling with their production parts," he explained. "If you do tooling, that's all they're going to give you; if you do production, that's all they're going to give you. They're typically not going to give you both."

But in today's economic climate, it can be tough to find good suppliers, so corporate buyers tend to stick with vendors they already know. AEC's years of experience and reputation in the industry allowed them to break through the tooling / production barrier and utilize their existing customer base for both types of work. "We've been around a long time," Kenney said. "They know who we are and what we're capable of, so they want us to do the work."

Up to that point, only about five percent of AEC's work had been production. "We were running some production parts, but very limited," notes Bob Jeppesen, AEC's marketing manager. "Our big concern was that, if we were going to get into the production atmosphere and get real serious about it, we had to get into high speed [machining]."

If AEC wanted to increase their percentage of production machining, it was obvious they would need to invest in more – and faster – equipment.

According to Kenney, "Speed doesn't buy you much in tooling, because you're talking one part. By the time you get the bugs worked out so you can run it up to high rpm, you're done." But production parts are usually machined in large batches, so high speed and reduced cycle times are required to keep the price per part competitive. "We knew we couldn't run the parts fast enough on our old machines," Kenney said, "they just wouldn't cut it. It was obvious we had to do something."

AEC looked at a lot of different manufacturers before deciding to invest in Haas CNC machines. Price, availability, high speed and service were some of the key factors in their decision. "We knew we were going to add some machines," Kenney explained, "and I didn't want to be dependent on Japan or the East Coast for parts and service. I don't want to go to Mecca, I want Mecca to come to me. Haas made that a lot easier."

A heavy influx of orders for production parts soon necessitated that AEC quickly add equipment to their machine arsenal. They purchased their first Haas machine – a VF-6 with 64" x 32" x 30" travels – in June of 1996, and have since added a VF-1, a VF-3 with Haas Automatic Pallet Changer, a VF-7, a VF-8, a VF-10 and three (3) VR-11 five-axis profiling VMC's. Five more machines are scheduled for delivery in 1998.

For added flexibility, most of AEC's Haas machines are equipped with high-torque 10,000-rpm spindles, expanded memory, probe-ready packages, 1,000 block / second processors, and 4th- and 5th-axis controls. "We have them all set up so we can do anything with them," Kenney said. "We learned a long time ago that it's cheaper to buy features now, than try to retrofit them later."

Kenney reflected that, "With some of the other manufacturers, you can't get delivery on big, heavy machines for 14-16 months. We couldn't wait. You have to machine parts when the orders are there, or you lose out. We knew how long it would take us to run the parts on our existing equipment, and we knew we had to do it faster if we wanted to be in a competitive position in the market-place. The Haas machines have put us in the right place."

Frank Escobar checks a completed emergency escape hatch upper sill that was machined on one of Aircraft Engineering's three Haas VR-11s.

But being in the right place means more than just having machines on the floor. It means having the right machines, and having them up and running. "When we ➡

Aircraft Engineering currently has nine Haas machining centers on their shop floor, with several more machines scheduled for delivery in 1998.

have a Haas roll in the door, we figure it's going to be online in a week," Kenney said. "If we bring a VF-10 in here on Tuesday, it will be up and running Friday. And, the availability of parts and the service staff are excellent."

Jeppesen added, "We have machines right now that, when we get in a bind for replacement parts, we have go to Japan for them. Even expediting them and express shipping everything, you still lose a week. And if it's an older machine, it's going to take you months. If you're not making deliveries, you don't get any more orders. They don't care what kind of equipment you have. You're out of business."

At present, about 50% of AEC's business is machining production airframe parts, and that percentage is increasing. Their goal is to position themselves as a "first-call" supplier for major manufacturers such as Boeing and Lockheed/Martin. To this end, they are buying machines with larger travels and certifying their accuracy.

"Any mom and pop shop can buy a smaller machine like the VF-1 or VF-2," Kenney explains, "but they don't have the funds to buy the larger VF-6s, 7s, 8s and 10s. So, we're trying to keep more of our machines in that higher end of what Haas has to offer. A lot of other manufacturers don't have the length, the X travel. Haas has the length. We've got those 120" VF-10s and VR-11s, and we can run a long part that nobody else can really run in a timely manner. We've run parts over ten feet long in our VF-10," Kenney continued. "We leave the door open, run it out the door and shift it. They've enabled us to get more work."

With the larger machines on the floor, AEC has been able to get work that some of the smaller shops can't do. But getting the work and meeting production schedules doesn't mean a thing if the parts aren't accurate.

"One of the things we're working on," Kenney said, "is buying the parts directly off the machine. Right now, the parts go from machining to quality control, where they're inspected 100%. By using probe systems and in-process inspection, we hope to reduce much of the inspection process. We won't eliminate it all – the part still has to be inspected – but we won't have to touch every dimension, every hole," Kenney said. "There aren't many people in the world who are certified to do that for Boeing, and we're close."

Since Boeing is one of their primary customers, AEC is in the process of qualifying their Haas machines in compliance with Boeing's ATA standards (a set of standards used to determine the level of accuracy and repeatability achievable by a particular machine at a particular supplier). Consisting primarily of a ball bar test, laser calibration of the machine and a test plate, these standards determine the level of work – i.e. very critical, critical, etc. – Boeing will release to a certain supplier.

AEC's SPC Administrator Werner Van Raay: "What's most important here isn't the laser cal, or the ball bar or any of the other tests, it's the plate. Because that plate is going to establish where you are on Boeing's scale, as far as accuracy and capability. The test plate is the thing that says, 'This is what you're qualified to do.' The tighter the tolerance on the plate, the higher you get on Boeing's list. I want to put as many machines as I can out there, so that when they look at our list they say, 'Okay, this is their capability, and man, look at all the machines they've got.'" At present, AEC has qualified four of their nine Haas machines for ATA; two more should be qualified by next month.

"We want to really know what the capabilities of the machines are, so that we can reduce inspection, make parts a little faster and know that the parts are right," Van Raay remarked. "As far as the Haas machines go, they're extremely accurate. We even had one Haas that pointed out problems with our CMM. We had a test plate off the VF-6 that kept showing a pattern that was out of square. We called Haas, and they checked the machine and proved it was in square. We kept checking and it turned out to be the CMM – it had settled on the foundation and was out of square."

Haas VMCs have provided Aircraft Engineering the high productivity necessary in today's competitive in the marketplace.

Aircraft Engineering uses their Haas VR-11s to machine 5-axis parts like this emergency escape hatch part in fewer setups.

This type of accuracy, as well as high speed, are the necessary ingredients for successful production manufacturing in the aerospace industry. AEC has been able to slash their cycle times and meet the high production rates and quality levels required by their customers.

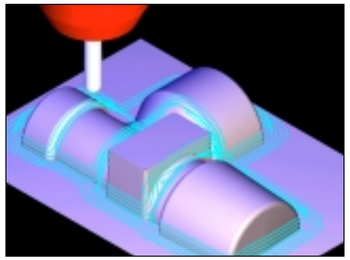
By adding Haas CNC machines to their stable of equipment, Aircraft Engineering Corporation has decidedly put the horse back where it belongs – in front of the cart. Having the machines on the floor ready to "rock and roll" has allowed them to successfully supplement their fluctuating tooling work with the stability of production manufacturing.

"Every machine has its place," Kenney said, "and we believe that Haas has its place in a shop of our type. You can tell: Nine of our machines presently are Haas machines, and we have more on order. We've been really pleased with the product."

Aircraft Engineering
15500 Texaco Avenue
Paramount, CA 90723-8075
562-634-2401

The CAM Question: How Much Does Your Shop Need?

Story
by Benjamin Mund
CNC Software, Inc.



During the past ten years, few aspects of manufacturing have progressed as rapidly as PC-based CAD/CAM technology. As with most innovations, the market presses for improvements, and eager hardware and software developers strive to meet the demands. But as PC-based CAD/CAM software grows more sophisticated, it becomes difficult for a shop to decide exactly what they require. As amazing as some of this software is, how much CAD/CAM capability does a shop really need?

To start with, the prospective buyer must determine the needs and desires of the company or department that he or she is working for. Get out into the shop! Take a look at your NC and CNC equipment. List the types of machines you are using, their abilities and the current work being produced on them.

It's also important to consider what type of work you plan to do in the future. Many shops prefer a system that lets them purchase the capabilities they need now, and also offers additional functions they can add as their needs change. This lets them build on their initial software investment and avoids the need to learn a new system later.

Despite the complexity of many systems on the market, a shop may only need specific CAM functions. For the purposes of this article, we have broken these functions into four general levels of complexity. The following is a quick rundown of these levels and how they relate to different types of work.

1. The Basics

A talented programmer can stand at a control and program a part with basic shapes and angles. However, this becomes much more difficult and time-consuming for a part containing complex curves, odd angles or shapes requiring multiple passes.

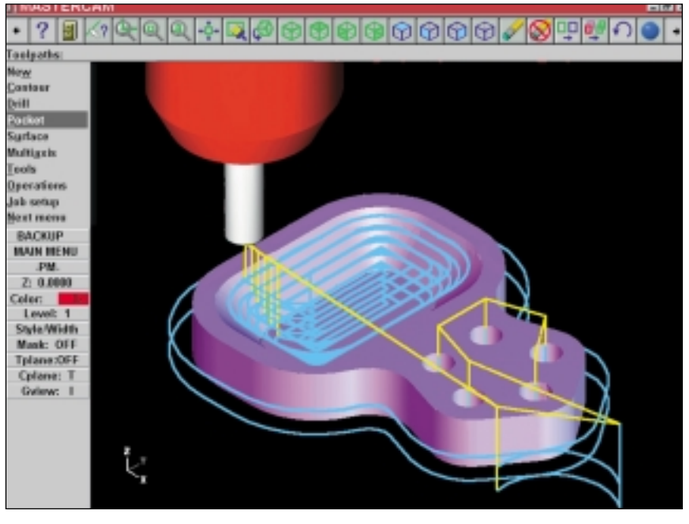
Simple 2D or 3D shapes can be machined in planar fashion with most CAD/CAM packages. Shops that do primarily 2 or $2^1/_2$ – axis work need a few basic machining functions and probably not much else:

• Contouring – programs the cutter to stay at a constant Z-depth while following a series of lines or curves.

• Drilling – instructs the machine to drill holes in the stock at different locations, depths and cycles. This type of function typically includes other plunge operations such as boring, counterboring, tapping and reaming.

• Pocketing – removes material from the inside of a boundary to create a cavity in the stock. Good 2D pocketing avoids islands within the pocket, and does not force the cutter into an area that is too small for it. Pocketing can be done in several different ways.

1. Zigzag pocketing moves the cutter back and forth across the cavity with the same step-over for each pass.



2. Spiral pocketing starts at the inside or outside of a pocket and spirals out or in until the stock is removed.

3. One-way pocketing creates a series of parallel passes in the same direction, allowing all cutting to be climb or conventional instead of a combination of the two.

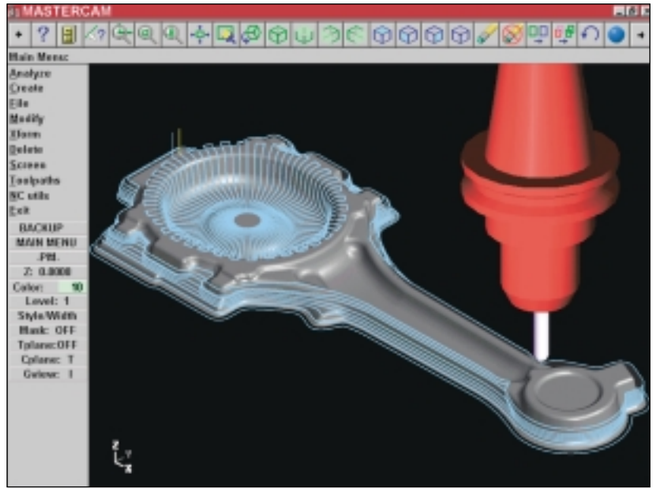
4. Morph pocketing creates a spiral toolpath that gradually changes from an internal to external shape, keeping a constant load on the cutter.

5. Facing cleans material off of the top an area that may lie between depths, such as the top of an island.

6. Pocket re-machining identifies areas left uncut from a previous operation and cleans out those areas with a smaller cutter.

• Toolpath Associativity – This maximizes the above processes by linking toolpath and geometry. If either the toolpath or geometry are changed, a new, updated toolpath can immediately be generated. This means that a part only has to be programmed once, with any changes made to the model or machining process updated with a single mouse click. For example, a programmer may want to change drill size and hole location on a series of operations. Rather than reprogram the entire set of operations, he simply selects a new tool, moves the geometry and clicks a button. The result is a new, accurate toolpath reflecting those changes.

Many shops find these 2 and $2^1/_2$ – axis CAM capabilities are well suited for a large number of their applications. More complex work can be done with these functions, but with increasing difficulty. In addition, shops often come across parts that are not extremely complex, but are difficult or impossible to program using $2^1/_2$ – axis functions. An example is a spherical-bottom pocket. Since the bottom of the pocket does not lie exclusively in the X-Y plane, toolpath functions with greater control over the Z axis are needed.



2. The Next Step – Adding a Third Dimension

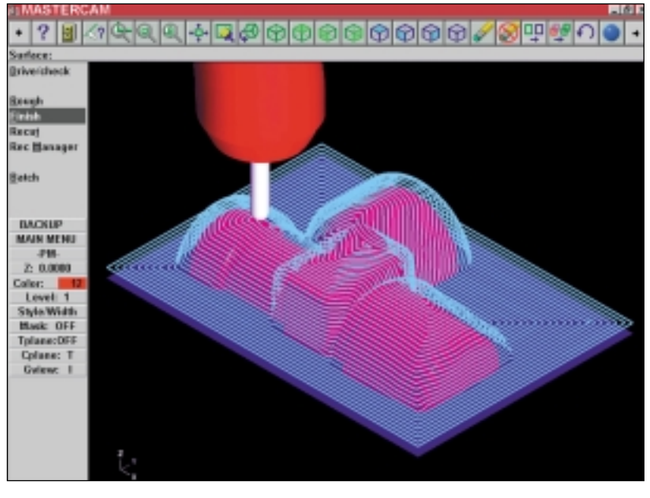
Most complicated parts with complex curvature can be defined using surfaces. A surface is a geometric entity that mathematically defines the curvature at any given point. Surfaces are applied to 3D geometry like a skin, and are trimmed or filleted together to fully define the curvature of the part.

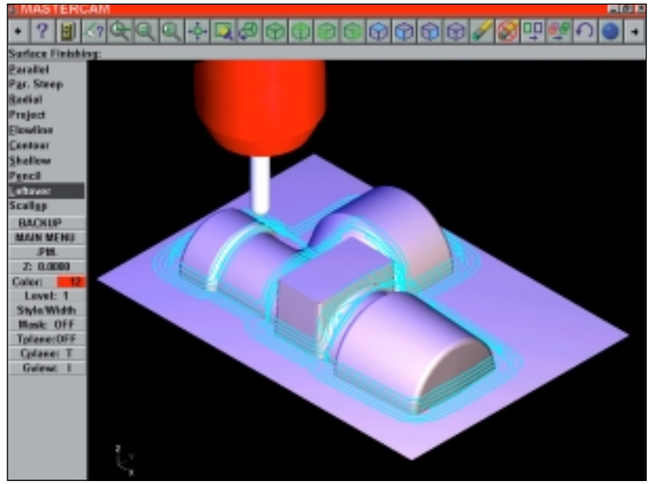
Surfaced geometry requires toolpaths that are flexible enough to follow sculpted shapes. One method of achieving this is through single-surface machining. This level of machining is suited to parts that can be defined with a few sculpted surfaces that are tangent to one another. Each surface can be programmed separately and the toolpaths can be combined into a single NC program.

Once projects become more complex and contain surfaces that are not tangent, machining with single-surface functions becomes somewhat difficult.

3. Multi-Surface Machining

Multi-surface roughing and finishing are suited for applications such as ➠





complex prototyping or mold making. These functions allow a single toolpath to be generated across multiple surfaces of any type. All selected surfaces are considered when calculating the toolpath, thus delivering a consistent finish and avoiding gouging.

A good CAD/CAM system offers several options for roughing and finishing a multi-surface part. This allows the NC programmer to choose the most efficient machining strategy for a specific project.

• Parallel machining – This is basic multi-surface machining. The tool moves back and forth across the model. Flexible parallel machining allows you to cut in zigzag or one-way motion.

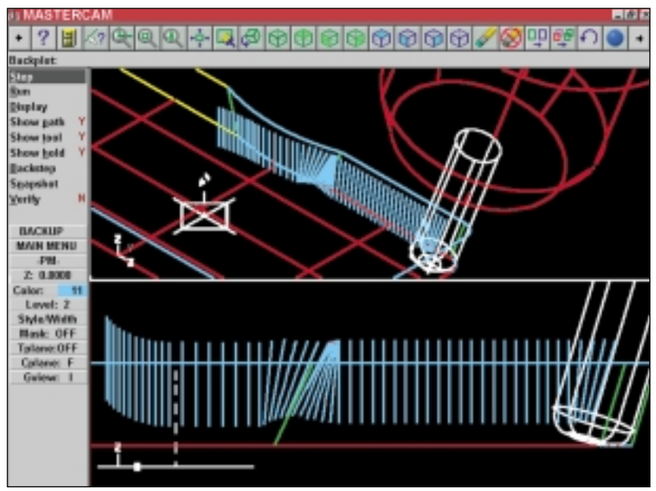
• Constant Z machining – This function cleans all the material from a given depth before moving on to the next depth. The result is less tool wear and a more consistent finish on some surfaces.

• Scallop machining – Scallop machining keeps a consistent tool stepover in 3D space. This provides a more uniform scallop height around the entire model and therefore reduces the amount of handwork required to finish a part.

• Flowline machining – Flowline machining uses the natural shape of a set of surfaces to determine tool movements, resulting in a more efficient toolpath.

• Radial machining – This type of toolpath radiates out from a center point like spokes on a wheel. It is ideal for spherical parts.

• Containment boundaries – Definable containment boundaries allow the programmer to define a specific area to be cut, even if it contains only parts of surrounding surfaces. This is useful when a specific area of a multi-surface part needs a different machining strategy than the rest of the part.



After a finish pass is run, there is often material left in small or hard-to-reach areas. A good CAD/CAM system provides automatic options to remove that extra material.

• Multi-Surface Leftover Machining – This function identifies areas that are left uncut by a previous multi-surface operation and programs a smaller tool to clean out those areas.

• Pencil Tracing – Pencil tracing walks a small cutter along surface intersections to achieve the best possible finish in hard-to-reach areas.

• Shallow / Steep Machining – This function identifies and machines steep and shallow areas that have scallops left from a previous cut.

These 3-axis functions provide most of what a complex mold, prototype or production shop needs. There are, however, additional machining options available.

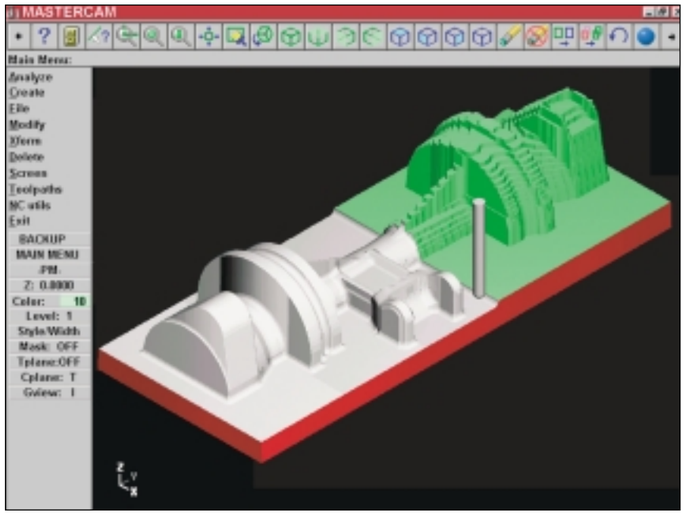
4. Machines That Do More

Some operations not only require software that is capable of generating the toolpaths, but machine tools that provide the appropriate capabilities.

• 4-axis machining – This adds a fourth dimension of simultaneous movement, and requires a machine with a rotary table or tilting machine head.

• 5-axis machining – This adds a fifth dimension of simultaneous movement, and requires a machine with one or more rotary tables and/or a tilting machine head. Good CAM software automates 4- and 5-axis requirements such as calculation of leads/lags and surface normal vectors.

• High-Speed Machining – Machines that support high-speed cutting need CAM that delivers features such as tangential entry/exit arcs, smooth tool direction changes and plunge roughing.



Additional Tools To Consider

There are several NC programming features which are important in all 2-, 3-, 4-, and 5-axis applications. These include:

• Post processors – In most systems, the post processor translates the toolpath information into NC code for the machine. Therefore, good post processors are essential in any level of machining software. CAM vendors typically have a library of these to run with most machines. Many CAM systems include user-customizable post processors, allowing programmers and machinists to make adjustments themselves or with a quick phone call to their vendor's tech support.

• Toolpath Verification – Solid model toolpath verification runs your toolpath on-screen on a piece of "virtual stock." The result is a solid model of the finished part that can be inspected from all angles to ensure the toolpath produces the desired results. This helps eliminate dry runs and test cutting.

• Data Translators – If a shop plans to receive files from other CAD systems, good translators are vital. If a shop can accurately accept a wide variety of data formats such as IGES (Initial Graphics Exchange Specification), they do not have to spend time recreating geometry that is already available. Many vendors provide these translators with their software, others charge extra.

• CAD Capabilities – Regardless of the type of work shops do, most find it necessary to have CAD capabilities as well as CAM. Even if a shop receives all its work electronically as CAD files, the programmer often needs to edit the geometry to make it machinable. Many shops prefer a package that includes both CAD and CAM. Using a tightly integrated CAD/CAM system eliminates the need to translate files between separate CAD and CAM packages. Since an integrated CAD/CAM system uses a common database for the CAD and CAM information, complete data compatibility is maintained at all times. In addition, this type of CAD/CAM system shares a common interface, avoiding the problem of training programmers on two separate systems.

Know Your Needs – For Today As Well As Tomorrow

When selecting the level of CAM capability you need, keep in mind your machines' capabilities, the type of work you produce now, and the type of work you plan to produce in the future. Many shops prefer a system that lets them add capabilities as their needs change. This allows them to purchase only what they require and lets them plan for the future by providing an upgrade path to more complex functions.

Choosing a system that grows with your business also helps reduce your learning curve. If your CAD/CAM package provides a growth path, you won't have to learn new software when you want to expand your capabilities.

Many CAM developers provide a family of software for milling, turning, wire EDM and other types of machining. If you decide to expand the category of machining you do, this lets you get a system with a familiar interface, further reducing training time.

Choosing a good CAD/CAM system with the correct functions helps you improve the quality, productivity and profitability of your shop. CNC Software publishes a booklet titled "What Every Shop Should Know About Choosing a PC-Based CAD/CAM System". The booklet provides useful tips on software and hardware selection, and discusses how to get the most from any CAD/CAM package. For a free copy of this booklet (a $4.95 value), call 1-800-228-2877, send an e-mail to info@mastercam.com, or write to "Free CAD/CAM Booklet", CNC Software, 344 Merrow Road, Tolland, CT 06084. CNC Software, Inc. 860-875-5006.

How To Select A Cutting Fluid

by richard j. chambers
Valcool Product Manager
Valenite, Inc.

The metalcutting industry today is well into the age of system solutions. What used to be the art of insert selection has been simplified and codified to the point where it can honestly be called a technology, if not a science. Grades, coatings and chipbreakers are all engineered to work together to perform more efficiently over an increasingly specific range of applications and workpiece materials.

One part of the metalcutting equation that is sometimes overlooked, however, is the choice of an appropriate cutting fluid. With today's system approach to metalcutting, use of the right metalworking fluid has become just as much a part of the solution as the other elements. In fact, at least one company is now integrating cutting fluids and cutting tools into effective metalcutting systems. Following are some things to consider when choosing your next cutting fluid.

The Four Key Questions

There are four vital pieces of information that are necessary when choosing a cutting fluid. They are:

1. What are you cutting?
2. What is the chemistry of your water?
3. What are you using now?
4. What are your options?
5. What do you prefer?

What Are You Cutting?

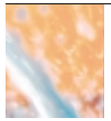
The first question – "What are you cutting?" – is often the most difficult to answer, because most shops handle a variety of workpiece materials on a regular basis. If the answer is an unequivocal "aluminum," or "stainless steel," or "cast iron," the selection of a cutting fluid can be quite simple and straightforward. Unfortunately, that is seldom the case in anything but a high-volume plant.

Where aluminum or other non-ferrous metals are a significant part of the mix, a non-staining cutting fluid is a must. Generally speaking, this will be a semi-synthetic with special ingredients to prevent bi-metallic corrosion and staining of non-ferrous workpieces. Where the ferrous metals predominate, however, a more general purpose semi-synthetic or hybrid fluid might be a more economical choice.

What is The Chemistry of Your Water?

The second question – "What is the chemistry of your water?" – is probably the single most common reason for the success or failure of a cutting fluid. Very few plants invest the money necessary to install effective water purification systems using deionization or reverse osmosis technology.

Unfortunately, the chemicals present, or not present, in the water used to re-constitute a cutting fluid make a tremendous difference in its performance and sump life. Most manufacturers of cutting fluids will perform the necessary water testing to determine exactly what minerals are dissolved in your water and make a fluid recommendation based on the results.



What are you using now?

The third question – "What are you using now?" – helps narrow the range of choices. When coupled with an objective analysis of the strengths and weaknesses of the current fluid, the answer to this question can quickly point you toward a relatively small number of competitive alternatives that have the attributes required to meet your cutting needs.

Many cutting fluids are in use today simply because they were in use yesterday. It is a hard reality of today's marketplace that if one isn't constantly striving to improve, they will certainly be overtaken by a competitor who is.

What Are Your Options?

The fourth question – "What are your options?" – leads to the final selection of a cutting fluid. Cutting fluids can be divided into four general groups, based on their chemistry. They are:

- Soluble Oils – quite literally, oil dispersed in water.
- Synthetics – completely oil free, man-made coolants in solution.
- Semi-Synthetics – a mixture of natural and synthetic lubricants with up to 30% mineral oil.
- Hybrids – a special class of semi-synthetics with a mineral oil content of about 15%.

Each fluid type has advantages and disadvantages which make it suitable for a particular group of applications. In addition, there are cost / performance trade-offs to be made between the groups within a specific set of applications.

For example, where a hybrid and a semi-synthetic may both be suitable for a particular use, the hybrid might provide longer sump life at a slightly higher initial cost, while some semi-synthetics may be more economical to recycle or dispose of while not giving as long a tank life.

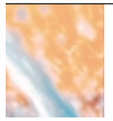
The final decision in this case would have to be made on the detailed economics of the shop where the fluids were to be used, and on the owner's individual preferences.

Soluble Oils

Soluble oils are oils that disperse in water when emulsifiers are added. They are generally suitable for moderate- to heavy-duty machining and grinding of all non-ferrous metals, carbon and cast steels, and in applications where dissimilar metals such as aluminum and steel are present. They can also be used in turning, drilling, tapping, reaming, gear cutting, broaching, as well as internal and centerless types of grinding operations. Soluble oils provide excellent aluminum and copper corrosion control; good rancidity control, which extends fluid for long lasting, trouble-free performance; and good concentrate and mix stability, making it ideal for mixing in water with a minimal amount of agitation. An example of this is Valenite's VNT®-650 premium heavy-duty soluble oil.

Synthetics

Synthetics are completely oil free solutions made of polymers, organic ➠



and inorganic materials that are mixed with water. These clear, low-foaming and bio-stable coolants are ideal for machining and grinding of ferrous materials, carbon steels or cast iron. Their complex lubricant packages make synthetics well-suited for tough-to-machine materials such as stainless steels and high-temperature alloys. Certain synthetics are specifically designed to address the primary failure modes of flank wear and nose wear. Although there are many benefits, some synthetics may cause staining of non-ferrous materials.

Semi-Synthetics

Semi-synthetic fluids are a mixture of oils, synthetic emulsifiers and water. They were primarily developed for the aircraft, nuclear and related industries. Consequently, they work extremely well on all non-ferrous metals such as titanium, aluminum, copper, brass, bronze and stainless steel in both machining and grinding. Semi-synthetics can be used on ferrous metals, too. They are chlorine-free to reduce bi-metallic corrosion and staining of metals. They should be used at a 5-8% dilution with water, depending on the severity of the operation.

Hybrids

Hybrids are cutting fluids custom engineered to solve a particular problem. For example, Valenite's VNT®-800 was developed to be very clean in the machining and grinding of cast iron. It provides better stability in hard water and rejects tramp oil very well, which adds to its bio-stable chemistry. Hybrids work extremely well on all metals in both machining and grinding. They should be mixed at a 5-7% dilution with water, depending on the condition of the water.

What Do You Prefer?

The final question – "What do you prefer" – is usually the "tie breaker" where there is more than one appropriate cutting fluid available. Here, again, as in the case of what is being used now, the key is to examine your preferences objectively and specifically to identify the real reasons behind a preference. If you cannot point to specific reasons why one class of cutting fluid is preferred over another, you are well advised to follow the recommendations of the professional who has analyzed your requirements.

Choosing the right fluid today is easier than ever, as the system approach to metalcutting productivity continues to grow in acceptance. The day is not far off when choosing a complete solution will be as easy as choosing the right insert and chipbreaker today. The answers are available, and the results will more than justify the time you spend choosing the right metalcutting fluid.


Race Report [Continued from page 3]

Troy Cline gets sideways.

Photo courtesy M&M Photos

C&C Motorsports SCRA (Sprint)

Joe Custer, in partnership with Troy Cline, is entering his second year of involvement with Haas Automation sponsorship in local Sprint Car Racing Association (SCRA) events.

Tearing up the competition and throwing more dirt than a soapbox politician up for re-election, both cars on the C & C Motorsports team are running highly modified small-block Chevys in a sideways slide towards victory at any number of tracks in the southwest.

With 37 race dates scheduled for the '98 SCRA calendar, plans are currently in the works to host a special "Haas Nite" for team supporters at one, or both of the race dates at the Ventura Raceway, May 30, and September 5. Look for "The Haas Pit" hospitality station in the pits and give a collective cheer for Custer and Cline as they carry the Haas Automation name to yet another automotive victory.

South Africa:

"Group N" Opel Astra

International competition finds the Haas Automation South Africa logo carried on the South African Group N Opel Astra of Gary Marais. Marais is a very popular driver, known for his aggressive driving techniques (shown here making good use of his competitors in a rather un-orthodox cornering maneuver). Marais, a former Rookie-of-the-Year award winner was also sent to Europe where the car competed in a number of saloon car races.

Super Series Off Road

Off-Road racing fans in the Southern Hemisphere have no trouble seeing the Haas SA sponsorship on Buks Carolin's Chenowth VW buggy. Front-runners are always the cleanest competitors and Buks, already a national off-road champion, earned the crown as short course champion of the South African Total SuperSeries at AA Kyalami. Carolin's tube-framed dirt slinger claimed the Super Special category title for tube-framed cars with a trio of wins.

MTS/Trinity ATV Racing:

Machining Time Savers (MTS), Haas' distributor in Southern California, has entered into a sponsorship agreement with Trinity Racing backing the team's multiple-vehicle involvement in major national and international all-terrain vehicle (ATV) events. The six rider pro team competes in Grand National Motocross and TT, Grand National Cross-country, PACE Stadium Series, SCORE and "Best in the Desert" events.

Trinity Racing riders are supported at events by the team manager, engine tuner, suspension specialist and a chassis consultant. Operating out of a custom painted 45-foot enclosed trailer, the "Trinity Racing Team" will in effect promote the many ATV products and services the Trinity Racing name represents, including the fabrication of numerous billet bolt-on mods to the building of full-on racing engines.

Riding identically prepared Suzuki 500 ATVs utilizing a Lonestar chassis and Trinity-modified motors, all of the race vehicles will use the same brand products and run the same color scheme and sticker placement to assure team recognition on the circuit.

Trinity Racing presently is using Haas CNC machines (3-mills and a lathe) in its Anaheim, California, shop where experienced technicians prepare some of the hottest running powerplants around. The operation is also well-known for fine-tuning race-prepped engines used in jet skis and other forms of watercraft.

Haas South Africa Opel (left, or is it above?) finished 2nd in class and 3rd overall in South African Group N saloon car competition.

"We've known and depended on Trinity for a number of years now with our own ATCs," says Gary Sladek, manager, MTS. "We're looking forward to enhancing our relationship with this exciting partnership."

"This, in conjunction with the fact that the tunnel is designed to have good laminar airflow, boundary-layer control, and the proper speed and size to test automotive designs combines to distinguish our tunnel as one of the four built in the world of this type."

Milking the Unfair Advantage

Information gathered from this testing is then evaluated and turned into performance and efficiency on the racetrack. Because Swift depends on a fully computerized design/production system, any minor changes required in a body panel or part can be entered into the original program and the new part machined on one of Swift's Haas machines to exact tolerances.

In addition, any of these recommended changes can be reduced to the 45-percent wind-tunnel size and tested in the tunnel before the full-size part is cut. This is how Swift is able to design changes in downforce pressure of as little as 20 pounds in a car producing in excess of 4,000 pounds of force.

The Swift floorplan incudes ample workspace for assembly and machining.

And because everything in the Swift manufacturing/testing process is computer driven, absolute repeatability is guaranteed. If an internal modification demands changes in the exterior body panels, the appropriate changes can be entered on the computer, mocked up in scale for the wind tunnel testing, then cut full-size on the Haas machines for actual track testing.

This technology makes it affordable to design specific parts for different types of race tracks with the knowledge that these parts will generate the needed results. If a high-speed track demands less wing surface for high speed, yet sufficient body downforce for the turns, these panels can be engineered and tested for the specific parameters of the track.

Short track or road courses would demand different parts and pieces to augment handling characteristics for those tracks, giving the specific vehicle the fabled "unfair advantage" over the competitors. It's a win/lose situation, and nobody wants to buy a loser…and that's why the Swift Aero tunnel is booked well in advance.

Pacific Plant to Build Atlantics

In addition to Swift's Newman/Haas relationship, the company was recently awarded the contract for the construction of the new KOOL/Toyota Atlantic Series cars. The new Swift 008.a spec racers (47 cars ordered) feature carbon-fiber composite construction with a "raised-nose" design and are powered by the 240-hp Toyota 4A-GE engine.

This competitive series, now entering its 25th year, focuses on driver ability (all cars are identical in a "spec-racing" series) and the cars feature a number of parts and components designed, and built on Swift's Haas VF-8 and HL-2.

Swift was but one of eight manufacturers that participated in the design/build competition for the new Atlantic chassis.

The new design includes special attention to the survival cell in the areas of impact protection, including cockpit shape and helmet surround in addition to extra attention in the foot protection areas.

Future Plans & Priorities

There has been a lot of growth at Swift Engineering. During the past few years, the staff has increased from 11 to more than 85, and there are no signs of letting up.

Hiro says that in addition to building and selling the cars for the Formula Atlantic series, he envisions selling Swift 009.i cars to about three or four FedEx Championship teams. But he doesn't want to stretch Swift's ability to properly service these customers. Cross goes along with this philosophy adding, "We just want a few good customers. In that way, we'll have people winning races, and that sells cars."

Company plans call for more Haas machines, including an additional vertical machining center with more travel on the X-axis. This will allow the designers to machine molds for larger composite body panels and pans. In addition, more parts will be programmed for finish work on the existing machines.

"What's important about Swift and the engineering computer system is that it really is the start of a very integrated process," says Cross. "A repeatable, developmental process in which Haas machines are a very integral part."

Success at reaching long-range goals depends on teamwork and dedication to the latest technology. And to the Swift, go the spoils…

On the Horizon – New Product Rumors and Updates

ALWAYS striving to make inroads into new markets, Haas engineers have been hard at work developing new products. Rumors around the water cooler have the following machines in the works:

HS-2RP HMC

Debuted at last year's WESTEC, the HS-2RP is finally nearing production status. Nearly a year of development has yielded several changes to the original design.

- Extended travels – 38" x 35" x 30"
- Side-shuttle tool changer, 40-tool, travels out of the enclosure for unobstructed machining (60-tools optional)
- Three auger chip conveyor system – utilizes two side augers and a single front auger to remove chips from the enclosure during machining
- Lower overall height as a result of the side-shuttle changer
- 25,000 lb machine weight

HS-3 Prototype

This T-shaped horizontal with travels of 150" x 50" x 50" – by far the largest machine built by Haas to date – will have the following features:

- 30-hp, 50-taper vector driven spindle, 0–5,000 rpm
- 2-speed geared head
- 28-pocket, side-shuttle tool changer
- 45 mm guides on all axes
- 50 mm ballscrew on the X axis
- 40 mm ballscrews on the Y and Z axes
- 102" x 40" table with T-slots lengthwise and crosswise
- high-thrust brushless servos on all axes
- 42,000 lb machine weight

Haas Side-Mount Tool Changer

This 24-tool, 40-taper tool changer attaches to the side of the column on Haas VMCs, keeping the tools out of the enclosure for unobstructed maching.

Live Tooling, Lathes

Allows the use of standard 40 mm VDI rotary tools for axial and radial milling, drilling or slotting. A VDI turret can be supplied, or Haas VDI adapters may be used with the standard turret.

- 5-hp brushless drive for live tools
- Indexable main spindle
- Hydraulic brake for n
- Compatible with stan
- VDI turret available

HS-1,R,RP

- Redesigned base cas provide wider stance
- New internal sheetme and Z-axis waycover washdown for more efficient chip removal
- Three auger chip conveyor system – utilizes two side augers and a single front auger to remove chips from the enclosure during machining
- New pallet changer clamping system reduces wear and contamination

50-Taper Capabilities and Extended Travels in a Mid-Sized Package

In today's world, versatility is the name of the game. Job shops and manufacturers alike must react quickly to market fluctuations in order to survive. The new Haas 50-taper VF-5 vertical machining center (50" x 25" x 25" travels) combines the versatility of a mid-sized VMC with the power and torque of a 50-taper machine, all in a compact, heavy-duty package designed to meet the demands of today's modern machine shops.

The new VF-5 is built using super-wide-stance base and column castings, which provide the solid foundation and rigid backbone to take really heavy cuts. Combine this with extended X and Z travels 50-taper spindle that provides up to 450 ft-lb of cutting torque. A Haas-designed vector spindle drive yields peak performance and speed control under heavy cutting loads, and a two-speed gearbox provides the versatility of low-end torque for cutting steel, as well as speeds to 5,000 rpm for cutting aluminum alloys. Heavy-duty 40 mm ballscrews on all axes provide superior cutting rigidity, and 7.5-hp high-thrust brushless servo motors yield rapids up to 710 ipm.

For shops that don't need the power of a 50-taper spindle but want the travels of the VF-5, an optional 40-taper spindle is available in either 20- or 30-hp configurations

Making technology affordable:

How does Haas do it?

The five-axis spindle head of the new VR-11 provides an incredible ±32 degrees of rotation on the A and B axes, as well as rotational feedrates of up to 250 degrees per minute.

Fast, cheap and good. It's been said that you can have any of the two together, but not all three: You can have it fast and cheap, but it won't be good. You can have it fast and good, but it won't be cheap. Or, you can have it cheap and good, but it won't be fast. So, choose your poison.

With most things in life, this theory definitely holds true. But at Haas Automation, they've managed to accomplish the impossible and deliver all three: high-quality CNC machine tools that are delivered quickly and priced affordably.

Haas has always built products that are on the cutting edge of technology, yet priced lower than the competition. Making Technology Affordable is the driving force behind every new design or improvement, and the new VR-11 five-axis profiling VMC is further proof of this philosophy.

As with many new Haas products, the VR-11 was born of requests and suggestions from customers. There was a need, primarily in the aerospace industry, for a cost-effective solution for large 5-axis machining operations.

With its work envelope of 120" x 40" x 30" (xyz) and five-axis profiling spindle, the VR-11 fits the bill.

The first VRs are now in the field and getting a thorough workout at several aerospace shops throughout Southern California. If you are planning to attend WESTEC, be sure to stop by the Mastercam booth, where they'll be putting a VR-11 through the paces.

Our Customers Know Us As...

The Solutions Company.